



# Evaluation of Photochemical Grid Model Performance Using Data from the Lake Michigan Oxidant Study (LMOS)

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## Objective

To evaluate photochemical grid models using data from the Lake Michigan Ozone Study (LMOS) to determine the absolute and relative performance of the models and assess whether they can be confidently used to develop emissions control strategies.

## Approach

Three photochemical Urban Airshed Models (UAM-IV, UAM-V, and the regional oxidant model [ROM]) have been applied to two, 3-day ozone ( $O_3$ ) episodes during which extensive aerometric observations were taken during the 1991 LMOS. The models were run with identical source emissions and meteorological input data and with similar initial and boundary conditions. Three-dimensional time dependent model predictions of  $O_3$ , volatile organic compounds (VOCs), and oxides of nitrogen ( $NO_x$ ) were compared with observations. Ground-level maximum  $O_3$  concentration patterns and vertical profiles of  $O_3$  and precursors were emphasized.

## Accomplishments

Base model runs have been completed using current input information. There is little difference between the  $O_3$  predictions of the commonly used UAM-IV and UAM-V models. However, when coupled with ROM (for setting boundary conditions), UAM-IV tends to underpredict because of ROM underpredictions on the boundaries. Also, all models underpredict high  $O_3$  concentrations observed at the northern end of Lake Michigan and over inland Michigan.

Some sensitivity runs were made on the June episode in which (1)  $NO_x$  emissions were cut by 50% and (2) VOC emissions were cut by 50%. UAM-IV and UAM-V agree that the  $NO_x$  cuts have little effect on maximum  $O_3$  concentrations, while the VOC cuts cause maximum  $O_3$  concentrations to decrease by 20 or 30 ppb.

## Future Direction

Further sensitivity runs will be made on the July episode, using the same 50% emissions cuts already applied to the June episode. Also, specialized meteorological observations not used in previous runs will be added to the input files to attempt to correct the problem with  $O_3$  underpredictions in northern areas.



## Publications

Hanna, S.R., G.E. Moore, N.E. Bowne, and P. Pai. 1994. "Plans for Evaluation of ROM 2.2, UAM-IV, UAM-V, and SAQM with Aerometric Data from SARMAP, LMOS, and the Northeast," *Transactions of the Regional Photochemical Measurement and Modeling Studies Conference*, AWMA, Pittsburgh, PA.

Hanna, S.R. 1994. "Procedures for Evaluating Regional Ozone Models," *Proceedings, Third Workshop on Harmonization within Atmospheric Dispersion Modeling for Regulatory Purposes*, VITO, Boeretang 200, B-2400 Mol, Belgium.

Hanna, S.; G. Moore; M. Fernau. 1995. *Analysis and Evaluation of the UAM-V, UAM-IV, and ROM/UAM-IV Photochemical Grid Models for the Region around Lake Michigan*. Earth Tech Final Report, CRC/NREL 1349-403. July.

Hanna, S.R., G.E. Moore, and M.E. Fernau. 1995. "Evaluation of UAM-IV, UAM-V, and ROM/UAM-IV Couple Photochemical Grid Models with LMOS Field Data," paper 93 in *Proceedings of Ninth Joint Conference on the Applications of Air Pollution Meteorology*, AMS, Boston, MA.

Hanna, S.R.; G.E. Moore; M.E. Fernau. 1995. "Evaluation of Photochemical Grid Models (UAM-IV, UAM-V, and ROM/UAM-IV Couple) Using Data from the Lake Michigan Ozone Study (LMOS)," submitted to *Atmos. Environ.*

## Results of Ozone Predictions by Regional Models for Two LMOS Episodes

Comparison of Maximum Daily Ozone Concentrations*						
Episode	Date	OBS	UAM-IV	ROM/UAM Couple	UAM-V CALRAMS	UAM-V NWS
1	6/26	175	164 (-6%)	128 (-29%)	127 (-27%)	153 (-13%)
	6/27	118	159 (+35%)	127 (+8%)	131 (+11%)	142 (+20%)
	6/28	138	156 (+13%)	**	125 (-9%)	143 (+4%)
2	7/17	145	168 (+16%)	131 (-10%)	154 (+6%)	126 (-13%)
	7/17	170	184 (+8%)	147 (-16%)	128 (-25%)	161 (-5%)
	7/19	170	181 (+6%)	131 (-23%)	137 (-19%)	150 (-11%)
Mean Bias			(+12%)	(-14%)	(-11%)	(-3%)
Mean Magnitude of Bias			(14%)	(17%)	(16%)	(11%)

\* In ppb, with percentage biases in parentheses.

\*\* The 6/28/91 ROM/UAM-IV couple run was not made because the EPA UAM GMISS files do not include the final day of the EPA ROM run.